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The LLNL Cluster Tool

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The LLNL Cluster Tool
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Disclaimer

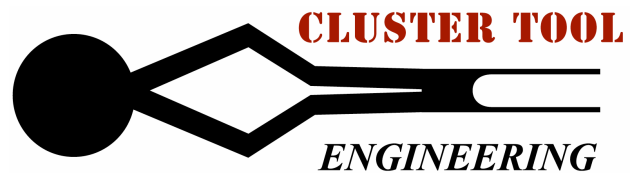
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The LLNL Cluster Tool



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Introduction



- **The Cluster Tool**
 - is a set of linked vacuum chambers
 - can deposit multiple layers of metal and metal oxides
 - Each layer can be deposited without breaking vacuum
 - Shadow masks can give each layer a different pattern
- **The Cluster Tool will be operational in April**



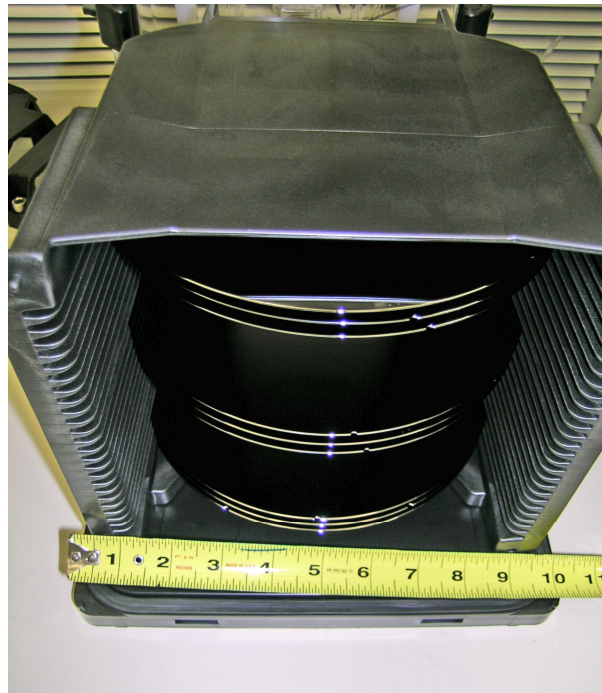
Benefits of a Cluster Tool

- **All components in linked vacuum chambers**
 - Reduced contamination
 - Prevent unwanted oxidation
- **Automated processing capability**
 - Many layers per substrate
 - Many substrates per batch

Our System



- **Two load locks**
 - **Cassette for holding multiple wafers or masks**
 - **Isolated from system with a gate valve**
 - **Roughing and hi-vac pumping**
 - **Can load cassettes without venting rest of system**



System (continued)



- **Wafer handling robot**

- Moves wafers and masks between load locks and process chamber (up to two more chambers can be added)
- Isolated from system with gate valves
- Roughing and hi-vac pumping

System (continued)



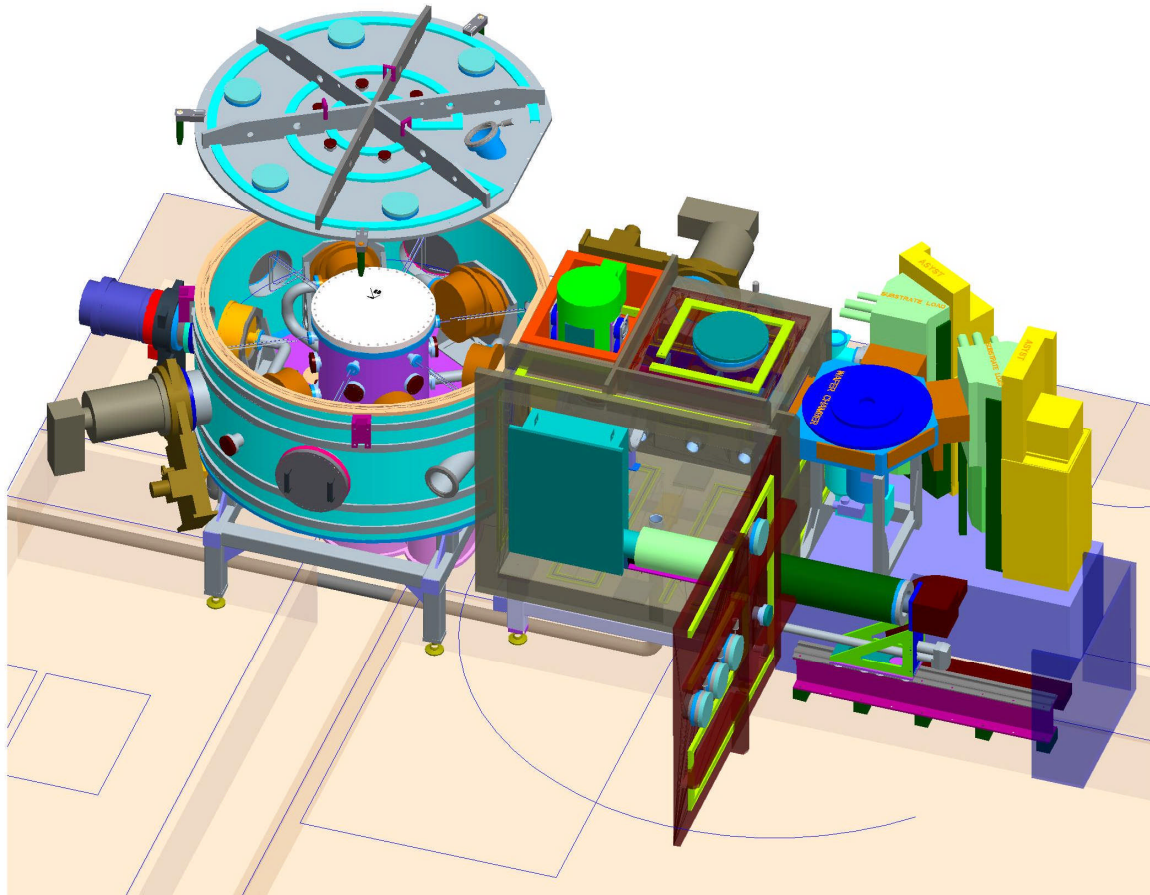
- **Substrate Chamber**
 - Electrostatic chuck holds 8-inch wafers
 - Chuck can inject gas around wafer for oxide or nitride coatings
 - RF bias capability
 - Magnetic clamping of shadow masks
 - 12-inch turbo pump
 - 14-inch cryo pump
 - RGA

System (continued)



- **Magnetron Chamber**
 - Rotating platter holds six reactive ion sputtering magnetrons
 - Three fixed magnet magnetrons
 - Three rotating magnet magnetrons
 - All magnetrons have 8-inch targets
 - All magnetrons use pulsed DC sources
 - Can sweep magnetrons back and forth for greater coating uniformity
 - 12-inch turbo pump
 - 14-inch cryo pump

System Model



System Photo





Coating capabilities

- **Start with Copper, Niobium, and Zirconium**
 - Add Aluminum and Gold in FY08
- **Can also deposit oxides and nitrides**
- **Can adjust the magnetron - substrate separation 4 to 18 inches**
- **Can adjust tilt angle of substrate during the deposition**
- **Can rotate the substrate during the deposition**
- **Can adjust the shadow mask - substrate separation during the deposition**

Shadow Masks

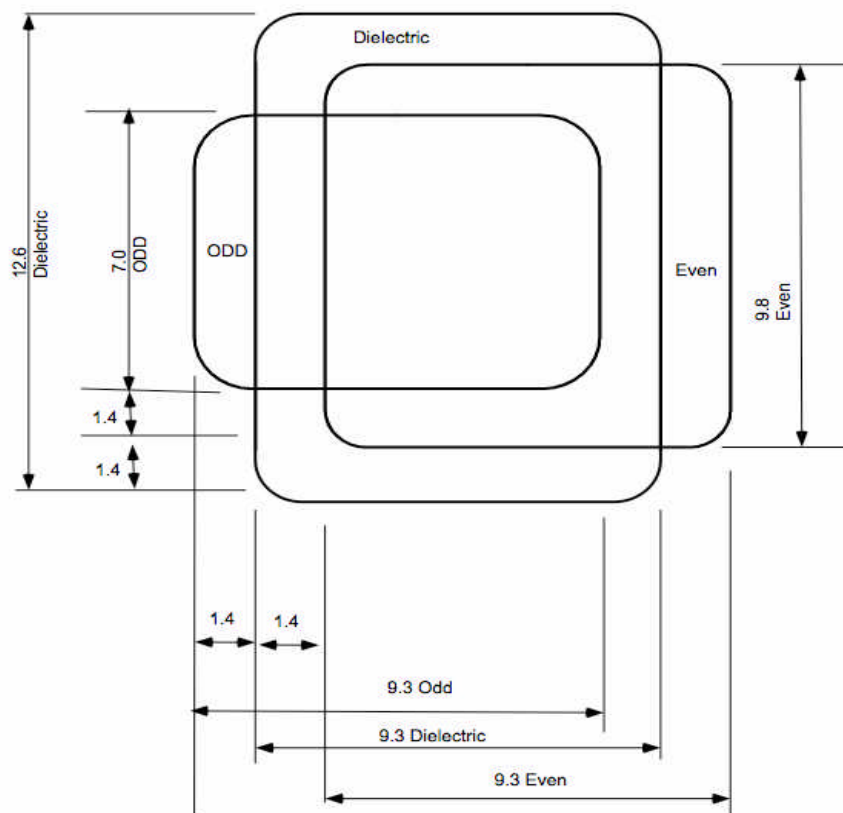


- Repeatability registration to 10 microns
- 1.5 mm thick Kovar, 225 mm diameter
- Gap to substrate adjustable in 14 micron steps

Capacitor example



Mask Overlay Pattern
1.0 mm radius typical
10/16/2006
Robert Chow



Conclusion



- **The Cluster Tool is nearing completion**
- **We will be able to deposit multiple layers, each with different geometries, without breaking vacuum**